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# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Improvements in or relating to Surgical Staplers

We, VSESOJUZYNY NAUCHNO-ISSLEDOVATELSKY INSTITUT KHIRURGICHESKOI APPARATURY I INSTRUMENTOV a Corporation organised and existing under the Laws of the Union of Soviet Socialist Republics, of 5 6, Fabrichnaya linia, Moscow, Union of Soviet Socialist Republics, do hereby declare the invention for which we pray that a Patent may be granted to us, and the 10 method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a surgical stapler particularly intended for applying circular staple sutures when effecting 15 anastomosis of hollow parts, especially the parts of the alimentary canal.

Previously proposed surgical staplers for effecting circular anastomoses between 20 hollow organs feature a tubular body which houses a central stem and a hollow movable rod carrying a cylindrical knife and a staple ejector, a stapling head, a detachable head with radial depressions against 25 which the staples bend and with a recess accommodating a replaceable resilient washer.

A disadvantage of such previously proposed surgical staplers is that each particular stapler is only suitable for applying 30 circular staple sutures to parts of a certain diameter depending upon the diameter of the tubular body of the particular stapler in whose end face portion grooves for 35 staples are provided.

It is common knowledge that the tubular parts of the human alimentary canal (i.e. the oesophagus, large and small intestines) have varying diameters even in the same 40 man. The diameters of said parts also depend on the age and habitus of a man, as well as other factors.

In order to effect circular anastomosis of

the parts of the alimentary canal, both the stapler body and its stapling head 45 are introduced into the tubular parts being sutured. It is evident that the diameter of the stapler must correspond to that of the organs to be sutured.

Another disadvantage of the previously 50 proposed surgical staplers is that their bodies are not variable in length.

However, experience in the clinical application of the previously proposed staplers has shown that, for effecting anasto- 55 mosis of the parts situated in deep operational wounds, staplers of greater length than those employed for effecting anastomosis of the parts located in shallow wounds are required. 60

A complete set of staplers having tubular bodies of different diameters and lengths is thus required which is inexpedient from the economical viewpoint, especially for 65 users to whom the acquisition of a number of such staplers will be rather costly.

An object of the present invention is to devise a surgical stapler for effecting cir- 70 cular anastomosis of all the parts of the human alimentary canal irrespective of their diameter.

Another object of the present invention is to provide a stapler capable of placing a suture at any depth of the operational 75 field.

According to the present invention there is provided a surgical stapler for effecting surgical anastomoses between parts of the human alimentary canal, comprising a body 80 with an extension tube made fast thereon having a tubular rod and a stem which passes inside said rod, a replaceable end-piece mounted on said stem and provided with depressions against which staples are bent for closure, means for moving said 85 stem axially, a stapling head comprising

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slots for accommodating the staples, a staple ejector and a cylindrical knife mounted at the end of said rod within said ejector, and a mechanical actuator for moving said rod and said knife, said actuator being located on the stapler body, said stapling head of the stapler being made as an individual structural component, being detachably mounted at the end of the extension tube, aligning means being provided for ensuring the correct relative disposition of the stapling head, the stem and the tubular rod, whereby the extension tube can mount stapling heads of different size so that the staple slots are positioned accurately with respect to the depressions made in corresponding end-pieces which can be mounted on said stem.

For ensuring simple and reliable operation of the stapler, said aligning means comprises a double-headed key fixed in position at the end of said extension tube and adapted to fit into longitudinal guide slots of the stapling head, tubular rod and stem.

In order to provide for a quick removal or mounting of the stapling head, in accordance with the invention, its tailpiece is threaded, and a union nut is loosely set on the extension tube for screw engagement with the tailpiece of the stapling head.

According to another preferred feature of the invention, a slidable staple ejector is built into the staple head and is fixed directly to the tubular rod by the knife which is screwed onto a threaded portion of the rod end extending into the staple ejector.

For varying the length of the stapler, according to the invention, the replaceable extension tube is made fast on the body by a union nut loosely set on said tube and screwable onto the threaded end of the body.

In order to accurately align the extension tube with the body, a groove is cut in the threaded portion thereof, and the corresponding end of the tube carries a key engageable in said groove.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic side view of a surgical stapler according to the present invention;

Fig. 2 is a sectional view of part of the stapler shown in Fig. 1;

Fig. 3 is a section on line A-A of Fig. 2;

Fig. 4 is a diagrammatic side view of a staple ejector of the stapler;

Fig. 5 is a section on line B-B of Fig. 2;

Fig. 6 is a diagrammatic bottom view of the tubular rod;

Fig. 7 is a section on line C-C of Fig. 2;

Fig. 8 is a schematic diagram illustrating the operation of the stapler;

Fig. 9 is a cross-sectional view of an anastomosis effected with the stapler of the invention;

Fig. 10 is a diagrammatic side view of the stapler fitted with interchangeable tubes; and

Fig. 11 is a section of the stapler at the place where an interchangeable tube is coupled to the stapler body.

Referring now to Fig. 1, of the drawings the surgical stapler according to the invention comprises a body 1 rigidly secured to an extension tube 2, a movable handle 3 articulated to said body 1 and a fixed handle 4 rigidly coupled thereto.

A replaceable stapling head indicated generally at 6 (Figs. 1, 2) is fastened at the end of the extension tube 2 by means of a union nut 5.

The stapling head 6 comprises a cylindrical sleeve 7 surrounding a splined ring 8 to define therebetween staple slots 9 (Figs. 2, 3).

Also inside the sleeve 7 is a slidable cylindrical staple ejector 10 (Fig. 4) provided with a basal hole 11 and with castellations 12 for driving the staples out of the slots 9. The ejector 10 is held in place inside the head 6 by means of a cover 13 (Fig. 2) which has a tubular tailpiece 14 externally threaded for engagement with the union nut 5.

A groove 15 is provided in the tailpiece 14. In order to ensure that the replaceable heads are correctly disposed relative to the extension tube 2, the latter is provided with an aligning device consisting of a double-headed key 16 fixed in place at the end of the extension tube 2. When mounting a stapling head onto the extension tube, the outer head of the key 16 engages the groove 15 in the tubular tailpiece 14 of the stapling head cover 13 (Figs. 2, 5).

Thus a strong and reliable fastening of the replaceable stapling head 6 in a fixed disposition at the end of the extension tube 2 is achieved. It is evident that the stapling heads may be made for both recurrent and once only use, i.e. of metal or plastics, respectively.

Running inside the extension tube 2 and the body 1 is a tubular rod 17 (Figs. 2, 6) provided with a threaded front portion 18 and a longitudinal groove 19 which serves as a keyway for the inner head of the key 16, whereby the rod 17 is fixed in the correct position.

A replaceable cylindrical knife 20 is screwed onto the threaded end 18 thereby forcing the ejector 10 against a shoulder 21 of the tubular rod and preventing it moving spontaneously towards the staple slots 9, whereby premature staple ejection is obviated.

A stem 22 lies inside the tubular rod 17,

said stem being provided with a longitudinal groove 23 to provide a keyway for the inner head of the double-headed key 16.

5 The pointed front end of said stem is provided with a thread 24 onto which a replaceable end-piece 25 (Fig. 2) is screwed. The diameter of the replaceable end-pieces 25 corresponds to that of the replaceable 10 stapling heads 6.

The end-piece 25 consists of three portions: a cylindrical portion 26, a taper portion 27, and a die portion 28.

15 The cylindrical and taper portions are interconnected to permit independent rotation of the taper portion round its axis when the cylindrical portion remains stationary.

20 The cylindrical portion 26 has a hole 29 (Fig. 7) so profiled as to suit the cross-sectional shape of that portion of the stem 22 whereon the end-piece 25 is mounted, so as to ensure that the end-piece 25 is always correctly disposed on the stem 22.

25 A cylindrical depression 30 (Fig. 2) in the end-piece 25 accommodates a single-use resilient washer 31 which protects the cutting edge of the knife 20 to prevent blunting thereof and aids complete excision 30 of the tissues during operation.

An annular recess 32 is provided at the bottom of the depression 30, the diameter of said recess being equal to that of the cutting edge of the knife 20.

35 The die 28 has thrust depressions 33 against which the staple ends bend when suturing.

40 A nut 34 (Fig. 1) is mounted at the rear end of the body 1, for movement of the stem 22 with the end-piece 25. The end of the stem facing the stapler body is provided with a thread 35 which corresponds to that of the nut 34.

45 In order to displace the tubular rod 17 and, consequently, the staple ejector 10 together with the knife 20, use is made of the movable handle 3. A short extension arm 36 of the handle 3 is made as a fork entering the body 1 through a port 37 and straddling flats 38 of the rod 17 (Fig. 6). 50 When the handle 3 is moved its arm 36 presses upon shoulders 39 or 40 on the tubular rod 17, thereby causing the latter to travel axially in either direction along the stapler depending upon the direction of movement of the handle 3.

The use and operation of the stapler in surgical practice is as follows:—

60 Prior to use the stapler should be prepared for operation, for which purpose the required diameter of the end-piece and stapling head with the knife required for the operation should be determined. Then, the slots 9 in the stapling head are loaded with 65 staples and an unused resilient replaceable

washer is placed into the depression 30 in the end-piece 25, whereupon the stapling head 6, the knife 20, and the end-piece 25 are mounted in position on the stapler. This 70 done, the end-piece and stapling head are brought together as far as they will go. In that position, the stapler is sterilized.

One of the several ways of using the stapler is for performing an "end-to-side" suture of the oesophagus with the intestine 75 as illustrated in Figs. 8 and 9. The stapler body with the stapling head 6 and stem 22 is introduced *via* a side incision into the lumen of the intestine. The stem 22 is then extended to pierce the intestine wall and 80 the end-piece 25 is screwed into position on the exposed end of the stem. A suture is provided around the open end of the oesophagus, the end-piece 25 introduced into the lumen of the oesophagus and the 85 suture drawn tight and tied. The tissues to be sutured by stapling are thus juxtaposed by rotation of the nut 34 to retract the stem 22.

Then, by pressing the handles 3 and 4 90 together, the rod 17 is made to move, causing the castellations 12 of the moving ejector 10 to act upon the staples so as to move them out of the slots 9. As they move the pointed ends of the staples pierce the tis- 95 sues being sutured and, upon meeting with the thrust depressions 33 in the head 25, are bent to assume a B-shaped form.

The knife 20, moving with the rod 17, forces the tissues within the circular stapled suture against the semi-rigid washer 31. As 100 the knife enters the washer the tissues are cut thus forming a circular anastomotic aperture 43 (Figs 2 and 9).

The instrument of the invention is applicable for effecting "end-to-end", "end-to-side", "side-to-side" and "side-to-end" ana- 105 stomoses.

In a modification of the stapler, there are provided replaceable extension tubes, rods and stems, which allow the length of 110 the stapler to be varied so as to be practicable for effecting anastomoses at any depth of location of the operational field (Fig. 10).

115 The principal component part of the modified stapler is its body 44 on which a replaceable extension tube 46 is fixed in place by means of a union nut 45. Each replaceable tube corresponds to its parti- 120 cular replaceable tubular rod 47 and a replaceable stem 48.

An accurate setting of the intermediate tube on the stapler body is attainable by a key 49 (fig. 11) fixed in position on the 125 extension tube and engaging a groove 50 provided on a threaded cylindrical portion 51, said groove being provided with a thread for engaging the union nut 45.

In all other respects, the design of the 130

stapler is essentially similar to that of the unmodified stapler.

WHAT WE CLAIM IS:—

1. A surgical stapler for effecting circular anastomoses between parts of the human alimentary canal, comprising a body with an extension tube made fast thereon housing a tubular rod and a stem which passes inside said rod, a replaceable end-piece mounted on said stem and provided with depressions against which staples are bent for closure, means for moving said stem axially, a stapling head comprising slots for accommodating the staples, a staple ejector and a cylindrical knife mounted at the end of said rod within said ejector, and a mechanical actuator for moving said ejector and said knife, said actuator being located on the stapler body, said stapling head of the stapler being made as an individual structural component, being detachably mounted at the end of the extension tube, aligning means being provided for ensuring the correct relative disposition of the stapling head, the stem and the tubular rod, whereby the extension tube can mount stapling heads of different size so that the staple slots are positioned accurately with respect to the depressions made in corresponding end-pieces which can be mounted on the said stem.
2. A stapler as claimed in claim 1 in which the stapling head includes a slidable staple ejector mounted therein.
3. A stapler as claimed in claim 1 or 2, in which the aligning means comprises a double-headed key fixed in position at the end of the extension tube and capable of engaging longitudinal guide grooves pro-

vided throughout the stapling head, the tubular rod and the stem.

4. A stapler as claimed in any one of the previous claims in which the tailpiece of the stapling head is threaded, and a union nut is loosely set over the extension tube, said nut being screwable onto said tailpiece of the stapling head.

5. A stapler as claimed in any one of claims 2-4 in which the slidable staple ejector is fixed directly to the tubular rod by the knife which is screwed onto a threaded portion of the rod extending into the ejector through a rear wall thereof so as to clamp said wall between the knife and a shoulder on said rod.

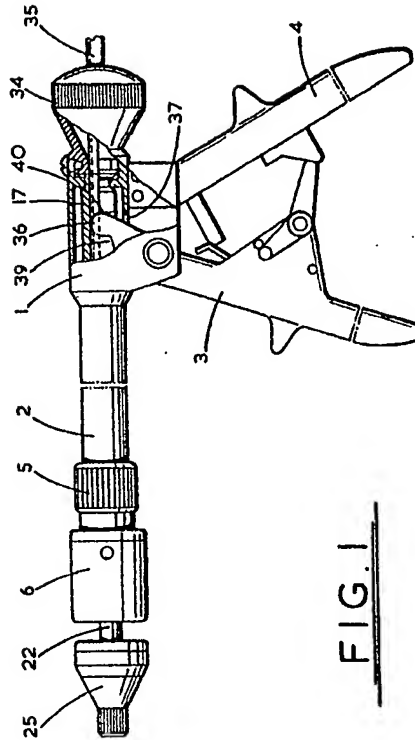
6. A stapler as claimed in any one of claims 1-5 in which the replaceable extension tube is fastened on the body by means of a union nut loosely set over said tube and screwable onto a threaded cylindrical portion of said body.

7. A stapler as claimed in any one of claims 1-7, in which a groove is provided in the threaded cylindrical portion of the body, and a key is mounted at the corresponding end of said tube so as to engage said groove.

8. A surgical stapler substantially as hereinbefore described with reference to, and as illustrated by, Figures 1 to 9 of the accompanying drawings.

9. A surgical stapler substantially as hereinbefore described with reference to, and as illustrated by, Figures 10 and 11 of the accompanying drawings.

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COMPLETE SPECIFICATION

6 SHEETS

*This drawing is a reproduction of  
the Original on a reduced scale*

Sheet 2

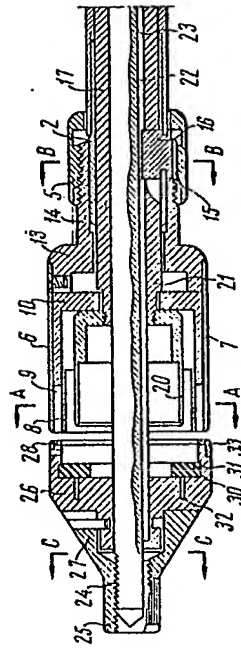
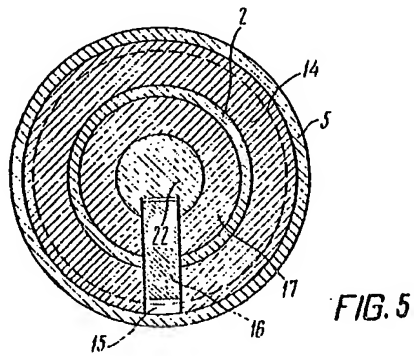
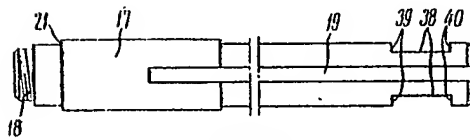
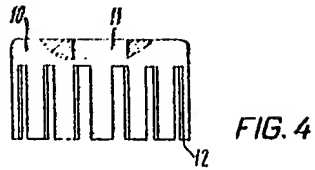


FIG. 2



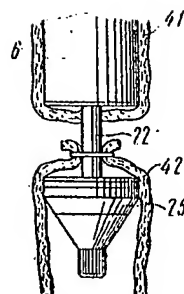


FIG. 8

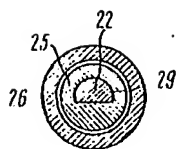


FIG. 7

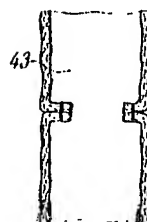
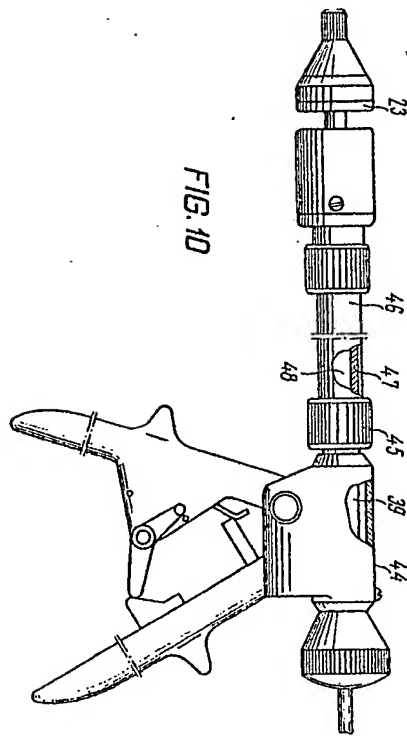


FIG. 9





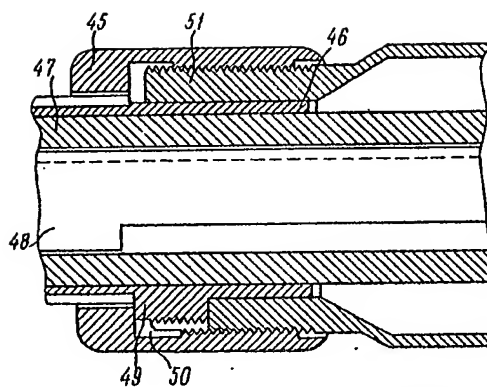


FIG. 11

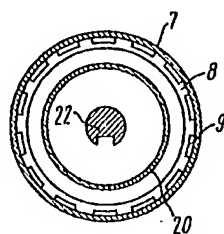


FIG. 3